Slash Disposal by Spot Burning and Dozer Piling in Ponderosa Pine Type

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Acceptance of the practice of slash disposal by conservative methods such as piling and burning represented one of the first major advances in forest conservation in the West. Slash disposal helped to prevent the build-up of conflagrations that spread into timbered areas. It protected much timber left by the loggers and advance reproduction from destruction by wild fires that all too often swept the slashings. It cleared the ground of debris that acted as a barrier to establishment of new reproduction.

Early slash disposal practices

Systematic slash disposal by piling and burning was first inaugurated in the West on the national forests. Some of the earliest disposal operations went to what now may appear like ridiculous extremes. In part, the early methods reflected a carry-over of European practices by foresters educated in Germany, France, and neighboring countries. In part, they also reflected the low value placed upon manpower in that period. When lumberjacks earned only one or two dollars or less for a 10- to 12-hour day, slash disposal of a high order was not the economic burden that such work would be today.

The merits of slash disposal were generally recognized eventually. Today reduction of logging slash is required by law in all western states, although standards have been lowered appreciably in comparison to the early leaf-raking practices.

Reasons for changing practices

World War II brought about a crisis in slash disposal in the West. Manpower was rapidly drained away from the woods by the Armed Forces and war industries. Such labor as was left to the timber industry was needed for production of essential forest products. It was literally impossible to employ enough sufficiently able workers to keep up with the disposal

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1/ Paper presented at meeting of Northern Rocky Mountain Section, Society of American Foresters, Missoula, Montana, March 19, 1948. The author wishes to acknowledge the assistance of those from whom the information was received upon which this report is based. Credit is due particularly to Harold Weaver, U. S. Indian Service, who originally was asked to prepare a paper for the Society of American Foresters meeting, but could not do so because of transfer to the Southwest.

of slash created by the accelerated timber cutting programs. Weaver pointed this out clearly and effectively in one of his papers. (9) For example, he mentioned that by 1944, the slash from 100 million feet of timber had accumulated on 17,000 acres of cut-over land on the Colville Indian Reservation. The situation was general throughout the West. Clearly here was a problem of major magnitude - a vast accumulation of inflammable material and reduced manpower resources for fighting fires.

Costs of slash disposal rose sharply even before woods manpower was channeled into the war effort. Workers were understandably showing increasing distaste for manual handling of slash. The work is strenuous and monotonous. The reluctance of the workers to pile brush could only be overcome by increased compensation.

New methods of slash disposal

Inevitably the slash disposal problems created by increasing costs and scarcity of manpower led to attempts to perform the work by other methods that cost less or required less manual effort. Two methods have appeared that hold much promise for meeting the objectives of saving cost and manpower in the ponderosa pine type. They are dozer piling and prescribed burning. Both have potentialities for harm as well as for good. They employ very powerful forces.

Dozer piling with special slash buncher teeth instead of conventional soil-moving blades is no longer an experimental method in ponderosa pine stands under certain conditions. It is a proven method that does better work for less money. Today it is in extensive use in widely scattered regions. Furthermore, it has been shown by Weaver that tractor slash bunchers can accomplish considerable silvicultural good as an extra dividend. (9, 12)

I do not know where or by whom the bulldozer slash buncher was invented. Perhaps it evolved independently in several localities. After all, in principle, it is merely a combination of a farmer's bullrake with a widely used earth-moving machine. Any crawler tractor operator who had worked on a hay ranch might have foreseen the possibilities.

Prescribed spot burning is a less generally accepted method of slash disposal for ponderosa pine type. Nevertheless it is another method that offers hope for cheaper and better slash disposal with extra silvicultural dividends if skillfully employed. Like slash-buncher piling, it does not appear to be the result of a single flash of inspiration. In part it has been adapted to ponderosa pine slash from earlier similar practices, in part deduced from shrewd observations, and in part reasoned out from consideration of the ecological requirements of ponderosa pine forests.

Fires beneficial to ponderosa pine

As early as 1910, Shattuck (6), who later served as Dean of the Forestry School at the University of Idaho, advanced the hypothesis that many ponderosa pine stands tended to be replaced by Douglas-fir in Idaho. In 1924, W. W. White (14), engaged in a study on the Bitterroot National Forest in Montana, stated that periodic fires help to maintain pure ponderosa types. The concepts that ponderosa pine forests are not always climax types; that at least in certain instances, fires keep out more shade-tolerant competitors, have been understood for 30 to 40 years. But the average forester did nothing about it. Slashing fires were too greatly feared. Many ponderosa pine stands regenerated successfully. The foremost foresters of the nation were almost unanimously in favor of the sure and safe method of slash disposal by piling and burning. To Harold Weaver, of the U. S. Indian Service, belongs the credit for applying prescribed burning in a scientific manner to the ponderosa pine type.

Thinning with fire

Weaver's first prescribed burnings were not applied to logging slash. He had observed that roughly 40 years of reasonably good fire protection, coupled with widespread mortality caused chiefly by bark beetles had created dangerous accumulations of inflammable debris in ponderosa pine stands on the Colville Indian Reservation and in many other localities. He also observed that during this same period of fire prevention and suppression, many areas had seeded in very densely to reproduction; sometimes ponderosa pine and sometimes Douglas-fir or other less valuable species. (8, 13) He inferred from study that overstocking on the generally dry pine areas is harmful in retarding growth of the reproduction, (11) and perhaps the overstory as well. He concluded that controlled broadcast burning might be a cheap and effective way to reduce the fuels and thin the reproduction. Such controlled fires might prevent or lessen the intensity of wild fires that would crown and kill the entire stand.

To prevent this paper from becoming overly long, I shall not repeat in greater detail Weaver's observations and reasoning. His ideas have been fully and clearly recorded in two papers that appeared in the Journal of Forestry. (8, 11) Within the limits of my experience, I believe that Weaver is dead right in thinking that occasional light fires in ponderosa pine stands serve to (1) thin beneficially or improve composition and (2) prevent accumulation of excessive volumes of fuel that can support and carry disastrous crown fires.

The first prescribed burnings on the Colville Indian Reservation were undertaken in the fall of 1942. Five plots having a total area of 238 acres were burned. (11, 12) In general, the stands were composed of patchy overstories of mature ponderosa pine, with densely stocked groups of pine reproduction and a few thickets of Douglas-fir. The reproduction was mostly around age 30 years. The patches of reproduction usually occurred in openings where groups of mature trees had died of bark beetle attacks. Usually there were several snags or large windfalls intermingled

with the clumps of reproduction. This is important because it contributed to the success of the thinning. When the fires entered the clumps, the dead trees were consumed completely and produced considerable heat. As a result, strips and spots of reproduction within the clumps were killed. The fire-killing was not as aimless and unsystematic as one might suppose.

Burning was carried out during comparatively favorable burning conditions, after a rather extended period of dry autumn weather. Weaver's account of the burning of plots 2 and 3 follow (7):

> "On the morning of October 9 it was found that, though no rain had fallen, the sky was still heavily overcast and conditions were still ideal for burning. Accordingly at 9:30 A.M., the backfiring was started at the highest point on the fire trail at station 34. One three-man crew with a Hauck torch proceeded north to station 36, while another three-man crew, using the second Hauck torch, proceeded south to station 32. Backfiring then ceased temporarily and was resumed only at intervals thereafter to make the line secure as the fire burned down the slope. By noon the entire northeastern portion of the plot had been burned and the fire was advancing slowly down hill along a line extending northwestward across the area from stations 31 to 41.
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> "At about this time the sky began clearing, and gusty, variable winds started blowing. As the backfiring proceeded south from station 31 it became apparent that because of such conditions we had fire advancing on a front that was too wide. The fire increased considerably in intensity and local "hot spots" developed. No trouble was experienced, however, except for one small spot fire over the line at station 30. This was speedily controlled and backfiring continued along the line to the south. When the fire reached the Douglas-fir thickets inside of the line, from station 27 south to 22, numerous "blow ups" occurred and the mushrooms of black smoke billowing into the sky caused considerable alarm amongst more distant, chance observers.
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> "By late afternoon when the backfiring along the east line of the tract reached station 23, the sky was again becoming heavily overcast, and a steady breeze from the southwest had developed. By this time the entire north line had been backfired and made secure and the fire was advancing on a wide, irregular front. Under such conditions the advisability of backfiring from station 23 west along the line on the windward side of the plot was debatable. It was decided, however, that because of the long fire front it was advisable to backfire the remaining line and to make it secure before leaving for the night. From station 23 west to station 3, therefore, the fire had the wind behind it as it swept through the thickets with considerable speed and intensity. By 6:30 P.M., the line had cooled sufficiently to be safe and the crew returned to Colville Agency.

"On the date of October 10 a small crew patrolled the line and felled several dangerous burning snags. No further patrol was necessary."

The cost of burning 123.5 acres in plots 2 and 3, including crew transportation, and line construction with a Hester plow and Cletrac "20" amounted to $122.34, or 99 cents per acre. The principal item of expense was for 12½ man-days of labor - $81.66. I am inclined to believe that at current salary rates, and with required payments for overtime, the charges might be almost double the figures reported. This would still be cheap for the benefits gained.

In the fall of 1947, 5 years after the fire, I had the opportunity of helping Weaver and his assistant, Francis S. Van Sickle, appraise the effects. Table 1 tells its own story.

Table 1.--The effects of prescribed burning

	Before fire	After fire	5 years later
Percent of plots stocked with ponderosa pine 1/	75	49	85
Percent of plots stocked with Douglas-fir	11	1	5
Number of ponderosa pine trees per acre	1647	421	939
Number of Douglas-fir trees per acre	37	2	15
Average height of ponderosa pine on plot (ft.) 2/	15.6	18.9	9.2
Average height of Douglas-fir on plot (ft.) 2/	13.8	0.5	0.5

1/ Basic 114 plots, each 1/250 acre in area
2/ Trees over 32 feet tall are not included in these figures

A fair number of the larger trees survived the fire. The excessive density of the clumps was reduced. A new age-class of reproduction - about 30 years younger than the previously established age-class, filled in most of the gaps. Today distribution is better than before the fire, but density is much lower. It must be conceded that fire doesn't do as good a job of thinning as an axe in the hands of a forester, but it does a reasonably acceptable job at far less cost.

Spot burning of slash

Weaver began prescribed spot burning of logging slash in the fall of 1943. The methods are approximately similar to those used in the thinnings as described. They differ in that (1) there is the additional fresh fuel from logging on the ground, and (2) the skid trails and truck roads serve as fire breaks. Some additional fire lines have had to be prepared with bulldozers. He has found propane torches well suited for igniting fires. Full advantage is taken of the opportunity to fire snags and windfalls as well as actual logging slash. All of this work as well as the tractor piling has been performed by the timber purchasers, working under the direction of Indian Service foresters, because the Indian Service must require slash disposal by the operator. The Indian Service, unlike the Forest Service, has no fiscal arrangement for force account slash disposal with cooperative deposits furnished by the operator.

Results in terms of slash cleanup, and harm to or desirable thinning of advance growth have been variable. Some fires have flashed through with only partial consumption of slash and occasional total misses. Others have burned too hot, and caused destruction of advance growth. Some burns have been exceptionally successful and have left the stands in a clean, park-like condition. The cleanup is decidedly more thorough than on comparable hand-piled and burned areas.

I have been unable to determine exactly how much slash has been disposed by the spot-burning method on the Colville Indian Reservation. From 1943, when the method was first used, up to December 31, 1946, the slash from roughly 80 million board feet of timber was spot burned on a total area of around 14,000 acres. (3, 10) Weaver has reported that the broadcast burning of 33 million board feet of slash on 5,350 acres cost 9 cents per thousand board feet. (9) Today he probably would want to raise this cost figure considerably - perhaps he would double it.

Weaver stresses the point that prescribed spot burning is a nerve-racking and unpleasant responsibility. It involves considerable risk in estimating burning conditions and changes in weather, and constant close supervision. He emphasizes the need for continual varying of pattern of setting fresh fires to fit the topography, fuel, burning conditions, and wind. Therefore, he favors tractor piling wherever it is possible, although spot burning is much cheaper. Spot burning has the advantage that it can be employed on steeper slopes where tractors cannot be maneuvered effectively.

Tractor piling on the Colville Indian Reservation

The tractor piling methods employed on the Colville Indian Reservation apparently do not differ greatly from methods used in other ponderosa pine areas, though perhaps there has been a tendency to employ larger and more powerful tractors in most other areas. The tractors now in use on the Colville Indian Reservation are D-4's equipped with factory-built slash-buncher blades. These factory-built blades are distinctly superior to many of the home-made modifications of standard earth-moving blades. They are lighter yet stronger in the right places, and give greater protection to the motor.

A clever modification that was pointed out to me on a machine on the Colville Indian Reservation was reversal of the radiator fan. This causes the circulating air to blow debris away from the radiator instead of drawing it in.

The machine operators I observed on the Colville showed great skill in extracting slash from tight spots without injuring residual trees. They have been trained to thin dense thickets, where it is desirable, by breaking through them, and to throw logging slash into jackpots of windfalls.

Small, limber saplings have a surprising ability to bend without breaking when a tractor passes over them. Many survive this rough treatment. The soil disturbance caused both by skidding and tractor piling creates conditions favorable to establishment of reproduction.

Weaver has carried over from broadcast burning to tractor-piled slash burning his practice of firing snags and windfalls. It reduces fire hazard and makes conditions more favorable for establishment and growth of reproduction. Up to December 31, 1946, slash from roughly 80 million feet of timber covering approximately 14,000 acres had been machine piled - practically the same volumes and areas as were spot burned. (3, 10) Currently, tractor piling costs 50 to 65 cents per M board feet and burning costs an additional 10 to 15 cents.

Several advantages of machine piling result from the piles being very large and the ground around the piles being clean. Burning can be performed in drier weather than with hand-piled slash. Hence, ignition is easier, fewer piles need to be ignited, and the piles burn cleaner. On the other hand, once the piles become wet, igniting is difficult and clean burning is uncertain. On the average, Weaver has found that tractor piling gives more complete destruction of fuels than spot burning.

Next year, it is tentatively planned to combine prescribed burning and tractor piling on the Colville Indian Reservation. The plan is to broadcast burn in advance of logging to clean up windfalls, snags and debris. It is believed this will make logging cheaper and perhaps safer. After logging, the slash will be tractor piled. This new proposal emphasizes Weaver's idea of continually varying methods to fit on-the-ground conditions.

Tractor piling in other districts

A hasty and very incomplete survey of experience with tractor piling in ponderosa pine in other parts of the Northwest has shown that tractor piling has been generally well received and its use is increasing. 2/ Comments are generally in agreement with Weaver's reports. Roffler (5) reported that on the Nezperce National Forest, from 30 to 40 million feet of slash have been piled with tractors. Costs have amounted to about 75 percent of the costs

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2/ The J. Neils Lumber Company and other logging operators who use tractor slash bunchers were not contacted for information.

of manual disposal, and the clean-up has been better. Some undesirable grand fir and Douglas-fir reproduction has been destroyed by the tractor. It is feasible to work slopes up to 35 percent with a D-7 tractor. Christensen (1) stated that the Colville National Forest has experimented with a 35 H.P. tractor but believes that it is too light. Guernsey (4) reported that the Kootenai National Forest is making tests with a D-7 tractor in ponderosa pine timber. Preliminary tests were found to cost about $1.10 per thousand, but he believes that the cost can be reduced about 50 percent and some of the cost should be charged to stand improvement and soil preparation, rather than to slash disposal.

Leslie L. Colvill (2) reported in the Journal of Forestry in 1946, that on the National Forests of Oregon and Washington, approximately 8,000 acres of ponderosa pine slash had been piled at a cost of from $8.00 to $14.00 per acre. He did not mention possible stand improvement benefits.

Further work needed

This completes my account of work and results to date. Before closing, it seems worthwhile to record a few observations about the significance of the progress to date and possibilities for future improvement. Tractor piling has made rapid improvements in methodology, and design of special equipment. It also has gained widespread adoption. This is consistent with modern advances and skills in the design and use of machinery, especially that ubiquitous implement, the crawler tractor. Further improvements can be anticipated. Silvicultural possibilities need more study, if advances are to keep pace with engineering developments.

Prescribed burning has made less convincing advances and has not been as widely tested in ponderosa pine. I believe that two basic classes of know-how need to be directed to prescribed burning to the same degree that engineering and mechanical skills have been directed to tractor piling. In the past, most of the attention to estimation of burning conditions, the spread of forest fires, and the consumption of fuels have been directed toward stopping forest fires in the ponderosa pine type. The art of suppressing fires should be put in reverse. We should turn some of our skills and research talent to learning how to burn to meet management and silvicultural objectives. For example, Weaver's most difficult problems would have been lessened if he had possessed a prescribed burning meter, similar to a fire danger meter.

The other cause of lack of progress can be attributed to silviculturists and forest managers. They have not implemented sound ecological theory in the ponderosa pine type.

Progress has been made with comparable problems of burning in the western white pine and southern yellow pine types. Further advancement of the art of broadcast burning in the ponderosa pine type needs joint action by forest managers, silviculturists and fire specialists. No one group working alone can attain maximum gains. Above all, it requires imagination, daring, and the courage of our convictions as has been exemplified by Harold Weaver.

CITATIONS

(1) Christensen, George F.
Memorandum in files of Northern Rocky Mountain Forest and Range Experiment Station. March 9, 1948.

(2) Colvill, Leslie L.
Development and use of Forest Service slash-buncher teeth. Jour. Forestry 44(2): 89-91. 1946.

(3) Head, W. W.
Memorandum to Commissioner of Indian Affairs. 1 page. June 16, 1947.

(4) Guernsey, W. G.
Memorandum in files of Northern Rocky Mountain Forest and Range Experiment Station. March 10, 1948.

(5) Reffler, Hans C.
Memorandum in files of Northern Rocky Mountain Forest and Range Experiment Station. March 10, 1948.

(6) Shattuck, C. H.
The forestal conditions and possibilities of the Clearwater National Forest. Typed manuscript. 81 pp. 1910.

(7) Weaver, Harold
Preliminary report on controlled burning experiments, Colville Indian Reservation. Typewritten manuscript. 21 pages. October, 1942.

(8) _____
Fire as an ecological and silvicultural factor in the ponderosa pine region of the Pacific slope. Jour. Forestry 41(1): 7-15, 1943.

(9) _____
Slash disposal on the Colville Indian Reservation. Jour. Forestry 44(2): 81-88. 1946.

(10) _____
Slash disposal on the Moses Mountain and Kartar Timber Units of the Colville Indian Reservation. Typewritten manuscript, 8 pp., May 29, 1947.

(11) _____
Fire - nature's thinning agent in ponderosa pine stands. Jour. Forestry 45(6): 437-444. 1947.

(12) _____
Thinning pine stands by prescribed burning. West Coast Lumberman 74: 111-114. 1947.

(13) _____
Management problems in the ponderosa pine region. Paper presented at Soc. of Am. Foresters meeting, ~~Portland, Oregon~~ Seattle. 8 pp. mimeo. Dec. 1947. (Submitted for publication to Northwest Science, 1948.)

(14) White, W. W.
Study of Lick Creek timber sale area 15 years after cutting. Typewritten manuscript. 25 pp. April 28, 1924.